IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Inventors:	Hisao KOGA, et al.	Art Unit: 2631
Appln. No.:	10/669,592	Exr. J. Patek
Filed:	September 23, 2003	
For:	COMMUNICATION APPARATUS	

PETITION TO MAKE SPECIAL

Assistant Commissioner of Patents
Washington, DC 20231

Sir:

The Applicants respectfully petition that the above-captioned application be granted special status. The requirements of MPEP section 708.02(VIII) are complied with as follows:

(1) Please charge the petition fee set forth in 37 CFR 1.17(i) to Deposit Account No. 19-4375.

(2) All pending claims (claims 1-12) of the present application are believed to be directed to a single invention; if the Office determines that all the claims presented are not obviously directed to a single invention, the Applicants agree to make an election without traverse as a prerequisite to the grant of special status.

(3) A pre-examination search has been made in the form of a search report in a counterpart PCT International Application (International Search Report dated March 9, 2004. Under MPEP 708.02, VIII, a search made by a foreign patent office satisfies the search requirement. An Information Disclosure Statement directed to the references cited in the ISR was filed on March 14, 2005.

(4) One copy each of the prior art deemed most closely related to the subject matter encompassed by the claims is of record in the form of the art cited in the Information Disclosure Statements filed July 13, 2004 and March 14, 2005.

(5) A Preliminary Amendment is filed herewith, in which the claims are amended for clarity and for cosmetic reasons and to remove unnecessary language. These amendments are considered to be non-narrowing, and no estoppel should be deemed to attach thereto.

(6) The following is a detailed discussion of the art of record, and comments pointing out how the instant claimed subject matter is patentably distinguishable thereover.

A. Discussion of All References of Record

(1) USPN 5,631,610 discloses a modulation circuit for a multi-carrier data transmission system that generates time domain signals for both I and Q signals by transforming symbol values into time

domain values and processing transformed values using a polyphase filter bank. The modulation system transmits a symbol set via a single side-band modulated carrier, and the demodulation system recovers the in-phase and quadrature signals from the modulated carrier. The object of the invention is directed to reducing the computational workload relative to that required to generate the I and Q components by directly computing the Hilbert transform of s(t). The modulation circuit receives M symbol values and generates M time domain samples for each of the I and Q signals, with the I and Q signals being combined to generate the single side-band modulated carrier. The modulation circuit includes a transform circuit that generates M transformed symbol values by computing the transform of the M symbol values, a polyphase filter bank having 2M FIR filters to process the output of the transform circuit, and a circuit to combine the outputs of the polyphase filters with the outputs of the polyphase filters generated from a previously received set of M symbols to generate the M time-domain signal values of the I signal. The Q signal is generated in a similar circuit. The demodulation circuit recovers symbol sets from the I or Q signals generated from M received time-domain signal values. The demodulation circuit includes a memory that stores the M time-domain signal values and a previously received group of M signal values, a polyphase filter bank having 2M FIR

filters, each filter having an input connected to the memory such that one of the received signal values is input to each filter, a polyphase processor that combines the outputs of the filters to generate M-polyphase values, and a transform circuit that transforms the polyphase values via a time domain-to-frequency domain transform to generate M symbol values. The demodulation circuit changes the sign of every other one of the M symbol values.

(2) USPN 5,636,246 discloses a multi-carrier transmission system in which a transmitter signal decoding apparatus corrects errors arising from synchronisation errors between transmitter and receiver, by forming weighted sums of symbols decoded by FIR filters, for a current frame and its adjacent frames. The invention is directed to providing an improved equalization method for use in a multi-carrier transmission system. The transmitter receives a sequence of symbols and groups the symbols into a block of symbols, each for modulating a different carrier, to be transmitted in a following frame. The receiver decodes the received signal by a plurality of finite impulse response (FIR) filters that are matched to the carrier waveforms modulated by the symbols in the transmitter. Errors arising from synchronization errors between the transmitter and receiver are corrected by forming weighted sums of the symbols decoded by the FIR filters for the current frame and frames received prior to and/or after the current frame. The

weights are determined by training samples sent on the communication link prior to the actual transmissions. The receiver may include a second bank of FIR filters that measures the amplitude of the signal in each of the carrier frequency bands after the signal has been phase shifted. The symbols generated by this second bank of filters are included in the weighted sum using weights that are also determined during the training session. The modulated carrier signals extend over a plurality of frames overlapping carrier signals from prior frames.

(3) USPN 5,497,398 discloses a multi-carrier transceiver for digital signal transmission using lapped transforms, which provides narrow-band and phase information, and corrects for phase shifts occurring on the communication link. The lapped transformation provides both narrow-band filtering and phase information and provides information on phase changes induced by errors on the communication link. The system computes the correlation of the most recently received W symbols with each of a set of M vectors, each vector having W components. The time-domain samples are then converted to analog signals for transmission. At the receiver, the last W time-domain signals received are stored, and analog signals are digitized and processed in groups of M symbols to generate a set of M modified data symbols by computing the correlation of the last W time-domain signals with each of a set of M vectors. The

modified data symbols are then corrected for attenuation and phase shifts.

(4) USPN 5,995,539 discloses a communication system which employs a polyphase filtration technique implemented by a wavelet filter pair. A Hilbert transform is used to phase shift the input signal by 90 degrees. The communications system wavelet synthesizes an original parallel data set into a serial signal, generates a test signal component within the serial signal, and transmits the serial signal over a transmission link. A receiver wavelet analyzes the serial signal into a recovered parallel data set, and extracts the test signal component from the received, serial signal.

(5) USPN 6,532,256 issued from a continuation application of USPN 5,995,539 discussed above.

(6) Henrique S. Malvar, "Signal Processing with Lapped Transforms," provides background of extended lapped transforms.

(7) FR 2800954 having correpondent PCT International Application WO 0135561A1 (in English), cited under Category X in the ISR, discloses a multi-carrier digital transmission system using transmultiplier filter banks in conjunction with orthogonal quadrature amplitude modulation. This document discusses a background approach using lapped transforms and wavelet transforms. The system includes an emitter which splits an input data stream into a number of substreams equal to a number of used subchannels,

performs orthogonal QAM (OQAM) modulation on each substream, employs a synthesis filter bank to produce a multi-carrier output digital signal. The system generates a synchronization and service data signal in at least one subchannel of the system. The system includes a receiver which includes an analysis filter bank that produces from an input signal a set of sequences equal to the number of used subchannels, each sequence being coupled to an input of a subchannel equalizer, a data extractor that processes equalizer output and feeds a parallel-to-serial converter that produces an output data stream, a detector that detects the synchronization and service data signal, an estimator that estimates a noise level for every subchannel and decides a number of bits to be assigned thereto, and a subchannel equalizer that includes a cascade of amplitude equalization units, a phase and residual amplitude equalizer and a fine equalizer.

(8) WO 03063380 has an effective date of July 31, 2003. This document is cited under Categories P, L and X of the ISR. It discloses a power-line carrier communication apparatus using wavelet transforms.

(9) M.C. Sun, et al., "Power-Line Communications Using DWMT Modulation," is cited under Category X in the ISR and discloses a discrete wavelet multitone modulation (DWMT) (which is a variant of OFDM) with an adaptive channel equalizer (a linear transversal

equalizer). The DWMT uses cosine modulated filter banks and discusses use of the extended lapped transform.

(10) E. Ozturk, et al., "Waveform Encoding of Binary Signals Using a Wavelet and its Hilbert Transform," is cited under Category A in the ISR and discloses communications using orthogonal wavelets transformed by a Hilbert transform to increase transmission rate without increasing bandwidth or the BER.

(11) J. N. Livinston, et al., "Bandwidth Efficient PAM Signaling Using Wavelets," is cited under Category A in the ISR and discloses communications using orthogonal wavelets transformed by a Hilbert transform (see Fig. 1).

(12) G. Cariolaro et al., "An OFDM System with a Half Complexity," is cited under Category A in the ISR and discloses complex OFDM transmission schemes.

(13) H. Bolcskei, et al., "Design of Pulse Shaping OFDM/OQAM Systems for High Data-Rate Transmission Over Wireless Channels," is cited under Category A in the ISR and discloses OFDM/OQAM pulse-shaping filters for high data rate wireless transmission.

B. Discussion of How the Claimed Invention Patentably Distinguishes over the References of Record

The present invention relates to a communication apparatus employing a digital wavelet multi-carrier transmission method that allows complex information to be treated.

The references cited above, either alone or in combination, fail to disclose or suggest at least the claimed subject matter discussed below:

(a) Regarding independent claims 1 and 8, it is particularly noted, in addition to the use of first and second wavelet transformers providing the I and Q components of the complex information, that both the first wavelet transformer and the Hilbert transformer operate on the waveform data of the received signal, and the second wavelet transformer performs a wavelet transform of the output of the Hilbert transformer. It is submitted that the art of record, taken alone or in combination, fails to teach or suggest this subject matter.

(b) Regarding independent claim 4, it is particularly noted, in addition to the use of first and second wavelet transformers providing the I and Q components of the complex information, that the first wavelet transformer and the second wavelet transformer preforming the Hilbert transform each operate on the waveform data of the received signal, and the second wavelet transformer performs

a wavelet transform of the output of the Hilbert transformer. It is submitted that the art of record, taken alone or in combination, fails to teach or suggest this subject matter.

(c) Regarding independent claim 8, in addition to the points emphasized in section (a) above, it is noted that claim 8 further distinguishes over the art of record in that it recites a transmitter that includes a synchronization data generator for generating data for synchronization that are known in the receiver; and an inverse wavelet transformer for performing an inverse wavelet transform of the synchronization data, and a receiver that includes an equalizer for performing equalization using both complex information obtained from the wave detecting section and a known signal for equalization that is previously assigned for the equalization process; a decision unit for making a decision using a signal obtained from the equalizer; and a synchronization timing estimating circuit for estimating a timing of synchronization from a phase difference between adjacent complex subcarriers output from the wave detecting section. It is submitted that the art of record, taken alone or in combination, fails to teach or suggest this subject matter.

(d) Independent claim 9 recites a communication apparatus including, *inter alia*, a transmitter that includes a synchronization data generator for generating data for

synchronization that are known in the receiver, and an inverse wavelet transformer for performing an inverse wavelet transform of the synchronization data, and a receiver having a wave detecting section including a wavelet transformer involving M real coefficient wavelet filters, which are orthogonal with respect to each other, for performing a wavelet transform of waveform data of received signal, and a complex data generator for generating complex data, by defining (2n-1)th outputs (n is a positive integer) from the wavelet transformer as in-phase components of the complex information and 2n-th outputs (where $1 \leq n \leq (M/2-1)$ and subcarriers are numbered from 0 to −1) from the wavelet transformer as orthogonal components of the same. It is submitted that none of the prior art documents of record teaches this combination of features.

(e) Independent claim 10 recites a communication apparatus including, *inter alia*, a transmitter having a modulating section including a symbol mapper for converting bit data into symbol data and mapping the symbol data to M/2 (M is a plural number) complex coordinate planes; an inverse wavelet transformer involving M real coefficient wavelet filters, which are orthogonal with respect to each other; and a complex data decomposer for decomposing complex data into a real part and an imaginary part such that in-phase components of the complex information are supplied to the inverse

wavelet transformer as (2n-1)th (n is a positive integer) inputs and such that orthogonal components of the complex information are supplied to the inverse wavelet transformer as 2n-th (where $1 \leq n \leq (M/2-1)$ and subcarriers are numbered from 0 to −1) inputs. It is submitted that none of the prior art documents of record teaches this combination of features.

(f) Independent claim 11 recites a communication apparatus including, *inter alia*, a transmitter having a synchronization data generator for generating data for synchronization that are known in the receiver, and a modulating section for modulating with the synchronization data; and a receiver having a wave detecting section having a wavelet transformer involving M real coefficient wavelet filters, which are orthogonal with respect to each other, for performing a wavelet transform of waveform data of received signal, a complex data generator for generating complex data, by defining (2n-1)th outputs(n is a positive integer) from the wavelet transformer as in-phase components of the complex information and 2n-th outputs (where $1 \leq n \leq (M/2-1)$ and subcarriers are numbered from 0 to −1) from the wavelet transformer as orthogonal components of the same, and a synchronization timing estimation circuit for estimating a timing of synchronization from a phase difference between adjacent complex subcarriers. It is submitted that none of

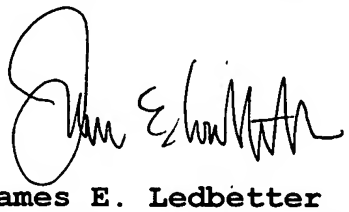
the prior art documents of record teaches this combination of features.

It is submitted that the above-noted combinations of features of the independent claims are not taught or suggested by the combined teachings of the art of record, and thus the independent claims, and all claims dependent therefrom, are patentable.

Accordingly, in light of the foregoing discussion pointing out how the claimed invention distinguishes over the cited references, the Applicants respectfully submit that the inventions of all the presently pending claims are not anticipated by these references and would not have been obvious over any combination thereof.

Grant of special status in accordance with this petition is respectfully requested.

Respectfully submitted,



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